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CANTOR LECTURES

ON THE

RECENT IMPROVEMENTS IN PHOTO-MECHANICAL PRINTING METHODS,

BY

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LECTURE I.—DELIVERED JANUARY 28TH, 1884.

NEW DEVELOPMENTS OF THE WOODBURY-TYPE PROCESS.

The printing press has been the main factor in bringing about that interdiffusion of thought, which has resulted in the widespread and complex civilisation of to-day; and it is especially of interest to note that the productions of the printing press have, even from the first, been permanent: that is to say, the ink used has been one made with a basis of lamp-black, the pigment which, of all others, seems best able to resist the continual breaking strain of time, while writings may be—and indeed often are—gone in the course of a few years.

The introduction of block printing into Europe, the discovery of a new world, and the construction of the camera obscura by Leonardo da Vinci, are events which mark the latter end of the 15th century, a period memorable in the history of our civilisation of to-day; the beginning, indeed, of that active fermentation of thought which has made the world what it now is.

When Leonardo da Vinci looked upon the wonderful nature-picture in his camera obscura, and dreamed of the possibility of fixing this shadow, it is difficult to imagine that his wildest thoughts could have led him to suppose the possibility of converting that shadow into a printing block, and making copies in the then new printing press.

The honour of first fixing the camera image belongs to Nicéphore Niépce, who, in or about 1816, first transferred and fixed the image of the camera upon paper, and not only this but Niépce actually made printing plates by photographic agency before the year 1827. Those pictures and printing plates, which represented landscapes or general views, were very imperfect it is true, but, some years before 1827, he made true camera pictures, which were fixed in the technical sense, that is to say, would bear subsequent exposure to light without disappearing, and he thus laid the foundation of those more perfect elaborations of his processes developed by Daguerre and by Talbot.

The perfection of united photography and printing is thus to make the shadow into a solid substance, and so to obtain a plate or block from which impressions can be taken on the printing machine, and in this direction much practical progress has been made since the time when it was my privilege last to address you.

One point to which allusion has just been made may perhaps be again mentioned. The printer, whether he work from type, from an engraved block, or from a printing surface obtained by the aid of photography, can select his pigment, and, as a matter of fact, he generally selects one of which the basis is lamp-black; consequently, exposure to light and air will not cause the print to fade. The photographer, who makes his pictures by a photo-chemical method, has to content himself with such a colouring material as he can get—generally metallic silver or a mixture of this metal with gold. The consequence is that the earlier photographs are now mostly faded, and one may safely say that not a single copy of Fox Talbot's "Pencil of Nature" can be said to have altogether survived the forty years or so which has elapsed since its publication. Notice the copy which is lying on the table, and see if you can find a single picture which shows no sign of fading. The first photo-mechanical process, however, which gave really good representations of scenes of nature, is the photoglyphic method of Talbot, and although the gradations of tone are not represented in quite the same degree of perfection as is the case with Talbot's pictures by his calotype or silver-printing process, we have the enormous advantage of permanency.

Here are some examples of Talbot's photoglyphic method, printed in ordinary carbon ink from the intaglio plate, and issued with the *Photographic News* in 1858. Where, indeed, will you find silver print a quarter of a century old which shows no sign of fading?

To unite the permanency of the press-print and its rapidity of production with the exactness of the camera picture is the aim of the photo-mechanical experimentalist; and let me now pass on to some of the advances made since the date of my last lectures.

During 1878, Dr. Eder, of Vienna, published a most comprehensive monograph upon the "Reactions of the Chromium Acids and the Chromates on Organic Bodies;" and, considering how largely progress in matters of actual practice is dependent upon sound theoretical knowledge, one is not likely to be wrong in attributing much of the recent progress to the labours of Dr. Eder. The series of articles in question will be found in the volume of the *Photographic News* for 1878. One of Dr. Eder's latest discoveries may be mentioned here. He finds that ferricyanide of potassium tends to make gelatine insoluble, and that exposure to light tends to restore solubility. Possibly useful methods of working may be founded upon this observation.

Great progress has been made during the past five years in the application of photography to lithography and type-block printing; indeed, at the time of my last lectures, it was the exception to find a London printer who made use of photo-transfers for litho work, or of photo-etched zinc blocks for type-printing; but now it would be difficult to find a large London printing house where these are not in regular use.

From the general to the particular, that is to say, to the special subject of this evening's lecture—printing by the Woodburytype method.

The old Woodburytype method, in which the mould is made by the hydraulic press, has not been improved to any notable extent, but new modes of working have been devised, in which the mould is made without the aid of the hydraulic press; indeed, more than this, for Mr. Woodbury has quite recently devised a method of working in which the gelatine relief is itself the printing surface, this gelatine being covered with a sheet of thin tinfoil, cemented down by means of india-rubber; but before describing this the newest and most successful modification, let me call your attention to some of the modes of making a printing mould from a relief without the help of the hydraulic press.

What is now going to be demonstrated will illustrate to you a process for moulding the relief, which was devised by M. Gustave Re. A compressible box, placed upon the bed of this small hand-press, is filled with plaster of Paris in a dry form, and a sheet of tinfoil having been laid over this, the gelatine relief is placed on the tinfoil, and pressure is applied. It is easy to understand that under these circumstances the tinfoil will be forced into all the details of the relief; but in order to produce a solid mould suitable for printing from, it is necessary to take means to cause the backing to consolidate itself together, and for this purpose some water is poured into an outer casing which surrounds the moulding box. Soon after the water has penetrated into the compressed powder, setting takes place, and as this is always accompanied by expansion, the metallic foil is still more closely compressed against the gelatine relief. It is scarcely necessary to say that the press is kept closely screwed up until the plaster has thoroughly set. It is my impression that no commercial use has been made of this ingenious method of moulding, but it, like many other processes, rests ready to hand for any person who may wish to make use of it or to improve it. Methods of making the printing mould by rolling pressure, instead of the direct pressure of the hydraulic press, have only been decidedly successful when extremely thin sheets of metal, such as tinfoil, has been used, as a thick plate of lead, or other soft metal, extends considerably in one direction, when under the action of the rolling press. Casting a printing mould from the relief in sulphur, or in what amounts to about the same thing, the so-called Spence metal, has been suggested, and Mr. Warnerke has carried the method into practice with success. By melting sulphur at a low temperature, and stirring in about one-sixth of its weight of black lead, a very good casting material is obtained, and this can be easily illustrated to you. Here is a relief which has been developed on a piece of thick glass, and warmed up to a temperature of nearly 50° Centigrade, and having placed a metal rim round the relief, the next step is to steadily pour over it the mixture of sulphur and black lead, so as to form a cast about an inch thick. When this is cold, Mr. Barker will separate it from the glass, and make a print from it by the usual Woodburytype method, that is to say, by pouring on to

the mould a pigmented gelatinous solution, laying on a sheet of paper, and then pressing out the excess of the coloured gelatine solution by bringing down a rigid and truly flat slab of metal on the paper. When the gelatine has set, the cast in pigmented gelatine will prove to be a perfect picture, showing all the gradations of the original photograph by various thicknesses of the tinted gelatine.

It will interest you to see some casts which Mr. Barry has made in brass and iron from the Woodbury relief, and although these do not appear to possess that perfect evenness of surface which is an essential in printing by the Woodburytype process, they are likely to have considerable value for decorative purposes.

Now, as to Mr. Woodbury's new development of his process, which he calls stannotype. There are two stannotype processes—the old and the new; but the former can be summed up in a very few words, especially as it has been altogether eclipsed by the latter.

The gelatine relief is developed on a rigid support, such as a slab of plate glass, and when the relief is dry, a sheet of tinfoil is made to adhere to it, and at the same time to take a perfect impression of the details, by pressure under a rolling machine. The next step is to deposit copper by the electrotype method on the tinfoil, the thickness of the copper thus deposited amounting to about three or four times that of the original tinfoil. The copper backing is now washed and dried, after which a warm sheet of glass, covered on one side with a layer of resinous matter, is laid — coated side downwards — on the coppered plate, and by the application of a steady and prolonged pressure, the softened resinous matter is made to accommodate itself to all the inequalities of the electrotyped surface. The whole being now allowed to cool, the complex cast is removed from the gelatine relief, and this cast is used as the printing surface. If you have followed my remarks, it is needless to remind you that the cast consists of the tinfoil facing which was moulded directly against the gelatine original, then the backing or stiffening of electro-deposited copper, next the resinous cement, and finally the rigid plate of glass intended to give strength or body to the whole. Mr. Barker will make a print in a mould of this kind.

The new stannotype process necessitates the use of a transparency, as the original photograph, under which the gelatinous tissue is exposed; and as regards the preparation of the sensitive gelatine, its exposure and development, there is no need for me to say anything, as this matter was fully treated of in my previous lectures. Carbon transparencies made direct from the original negative are used, and the representative of Messrs. Woodbury, Treadaway and Co., who is about to demonstrate the whole process, has just developed such a transparency in hot water, and he will now proceed to intensify it by means of a solution of permanganate of potassium.

A sheet of gelatinous tissue, which has been exposed under a similar transparency, is now soaked in water until flaccid, and laid face downwards on a slab of glass, perfect contact being established by the use of the squeegee. The glass to which the tissue now adheres is next placed in hot water, where the paper backing is stripped off, and all that gelatine which has not been rendered insoluble by the action of light is washed away. In this way a negative relief is obtained on the glass, the high portions corresponding to the light shades of the original subject, and the low portions to the deep shadows. When dry, this gelatine relief itself forms the mould in which pictures are cast or moulded by the ordinary Woodbury method; but before the gelatine mould can be used to print from, its surface must be coated with tinfoil. To do this, a thin solution of india-rubber in benzole is run over the plate, and a sheet of tinfoil being laid on, intimate contact is established by passing the whole between rubber-coated rollers—in fact, an ordinary wringing machine.

All is now ready for the printing. Mr. Woodbury's assistant takes the mould, adjusts it on the bed of a small press, oils the face slightly by a pad of oiled flannel, pours on the gelatine solution charged with colouring matter, lays on a sheet of paper, and closes the press, taking care to leave it closed until the gelatine is thoroughly set, when he will strip off the print.

This, then, is the new stannotype process, as adapted to the requirements of the general photographer who may wish to make fifty prints or more from a negative.

Another application of the Woodburytype method is the so-called photo-filigrane process, in which the water mark of paper is imitated by rolling a Woodbury relief against the paper with a considerable degree of pressure, the paper being rendered more or less transparent according to the degree of pressure, or in other words, according to the thickness

of the relief at any one particular point. In this way photographs of all kinds can be reproduced in water-mark form, and Mr. Barker will show you how very rapidly impressions of this kind can be made on the paper. The method in question is worked commercially by Messrs. Brown, Barnes, and Bell, of London and Liverpool, this firm having been good enough to send me the interesting specimens which are before you.

The Woodbury process is specially adapted for making transparencies to be exhibited by means of the optical lantern, and Mr. George Smith, who has been exceptionally successful in executing work of this kind, will now demonstrate to you the whole process of making slides by the Woodburytype method. Instead of laying a sheet of paper on the mould after flooding with gelatine, a glass plate is used, and the cast in tinted gelatine is thus made directly on the glass. Mr. Smith will use a hydraulic press of his own construction in making the relief, and those of you who have studied the construction of appliances of this kind will know how to admire the excellence of the design.

The translation of the Woodbury relief into a line or stipple, suited for lithographic or typographic printing, is a matter of considerable interest and importance, but it must be considered in another lecture.

LECTURE II.—DELIVERED FEBRUARY 4TH, 1884.

TYPE BLOCKS FROM LINE DRAWINGS OR HALF-TONE SUBJECTS.

Any impression in a fatty ink, of the nature of printers' ink, which may be transferred to stone or zinc for printing after the lithographic method, may be considered as the germ of a typographic printing block, as, if such an impression is transferred to a zinc plate, the uncovered parts may be etched away so as to leave the covered parts standing in high relief. The details of the method of this etching a zinc plate were given in one of the lectures of my previous series, and, therefore, it is needless to repeat them here. Let us take the reverse case. One has a typographic block, and it is more convenient to print impressions by the lithographic machine than from the block; it is only necessary to make a print from the block, and transfer it to the stone. Thus it will be seen that lithographic printing and typographic printing are very closely connected, so closely, that when a subject is prepared for one it may be printed by either, as convenience may indicate. The "Official Gazette" of the American Patent Office is set up in type, but the printing of all, excepting the index sheets and the covers, is done on a litho-machine.

These remarks bring us to the point where photo-lithography and photo-typography may be considered together, and that the making of a fatty transfer is equivalent to the production of a printing surface suitable for printing by either method. Still it seems to me that there is a large future before the litho-machine for commercial work, and that English printers are only beginning to see the real importance of Senefelder's discovery, for the production of commercial one-colour work.

Now, as to the making a photo-litho transfer from plain black and white work, some progress has been made of late by the introduction of the velvet roller as a means of inking the exposed gelatine paper; the application of the velvet roller to this purpose being due to Mr. F. Butter, of Woolwich Arsenal. The ordinary litho-roller sticks to the paper, and drags off the coating; so much is this the case, that, until the introduction of the velvet roller, but few persons attempted to ink up the image on the exposed gelatine paper with the roller; the usual practice being to follow the plan demonstrated in my last lecture—that is to say, to lay a ground of ink all over the paper, and, after softening the gelatinous film by soaking in water, to remove the excess of ink by dabbing, or some such process.

Mr. Newland will now assist in the demonstration of the mode at present adopted for making a transfer by the velvet roller method.

The sensitive paper was prepared by floating thin bank post paper on the following solution—the solution being, of course, warm :—

Gelatine	3 ounces.
Water	50 ,,
Bichromate of potash	2 ,,

An exposure of five or six minutes in the shade is sufficient, after which the paper is soaked for some minutes in cold water, and the excess of water is blotted off. All is now ready for the inking of the image, and Mr. Newland has clamped down one side of the paper to the front edge of a kind of table, formed out of a slab of thick plate-glass, after which he will apply the velvet roller; always rolling it away from himself, so as to keep the paper level and stretched. The exposed parts now take the ink, and a transfer of surprising fineness is obtained. The velvet roller is charged with an ink made by mixing commercial transfer ink with about one-eighth of its weight of olive oil, a little turpentine being added to thin the mixture, if required;* but it is well to avoid the free use of turpentine.

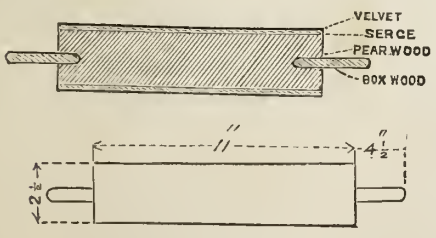
Mr. Frewing has been good enough to bring here some specimens of his line work, not only in the transfer but also put down upon zinc; moreover, he has brought some wood blocks upon which the fatty transfer has been impressed, as a guide to the engraver.

Wood-engraving has long held its own, but it is now very hardly pressed by the various processes, some of which are photographic and others not. Some years ago, the "graphotype" process made a little stir, but it did not compete with wood engraving to any extent worth mentioning, while, apart from the photographic methods, there are many others. Among the latest may be mentioned the glass etching process introduced by Mr. S. H. Crocker, of Sydney, and before you there are specimens of the *Australian Graphic* illustrated by this means. The resisting lines being obtained on the surface of the glass, hydrofluoric acid is used as an etching fluid, and, curiously enough, there seems to be scarcely any tendency to undercut under these circumstances.

So far we have only considered the use and production of transfers from such negatives as consist of only one gradation, clear white and intense black; and before passing on to the consideration of the means of obtaining transfers and blocks from ordinary negatives, in which every tint is reproduced more or less perfectly after the gradations met with in nature, let me point out to you some circumstances which will make it clear to you that we cannot, by simple photographic agency, produce representations from nature having quite the boldness of outline ordinarily met with in the most common kind of wood engravings; but there is now a movement among wood engravers to produce something better than was accepted twenty or thirty years ago —in fact, something more resembling a photograph.

Here is an engraving taken from the *Illustrated London News* of the year 1851—the year of the Great Exhibition—and here, on the other hand, is a quite corresponding subject from the number published last Saturday. In the older engraving the figures are outlined

* The following sketches and description, extracted from the *Photographic News*, will enable those who did not attend the lecture to sufficiently understand the construction of the velvet roller:—"Here is a sketch showing it complete and



in section. The measurements specified are those to he recommended, and in the section we show the materials of which the roller is made. After considerable experience, it is found that the best silk velvet is most suitable for the purpose. The body of the roller is of pear-wood, a light material most favourable to the purpose, while the handles are of hox-wood. Over the pear-tree hlock are sewn two layers of thick serge, and over the latter one thickness of velvet, the price of which is about 12s. a yard. A nice brisk nap is required in the velvet, and this cannot he obtained unless a good price is given. The serge, before it is sewn on, should he scalded in hot water, so that it will not ruck afterwards, and the velvet must be fitted by a skilled seamstress. The so-called carpet stitch is best adapted to the purpose, the ends of the velvet not overlapping, but drawn together so as to meet. In this way the seam is not a ridge, but perfectly flat, and the roller does not set-off at this spot. It need scarcely be said that this can only be attained with very fine stitches. The velvet is cut out exactly to size, and sewn on the block. The velvet roller is ready for use as soon as it is made. Unlike the leather roller, there is no need to get it into condition. In the same way, it may he put away in its linen hag as soon as done with, though, perhaps, it is best to clean first; the hag keeps away dust, and the grease in the ink will keep the velvet from becoming hard. Of course you can't scrape a velvet roller, to get the ink off, as you do a leather one; you can only free the velvet of its ink hy rolling. The roller is passed over a clean slah, and this is scraped from time to time. The slab gradually pulls the ink off, and this is then removed from the slab hy scraping. If you are not ahle to get off all the ink in this way, pass the roller over a thin sheet of soft paper, and apply a little turpentine. After a little practice, you will soon know when the roller is free from ink."

by bold black lines, and the attempts at reproducing the exact shades or gradations of lighting, which we may suppose were visible in the case of the originals, are crude in the extreme. To sum up, the outline is the essence of the engraving, and but little effort is made to reproduce the shades of the original. Now, look at the engraving taken from the last number of the *Illustrated London News*. We certainly have outlines of a similar character, but very much less clearly marked, and everywhere an attempt has been made to represent the lights and shades of the original by a corresponding closely packed collection of lines or dots. Now, look at a photograph of a strictly analogous subject. You see that the artificial outlines which the wood engraver uses to plot out his subject are altogether absent, and we only find that kind of shading which is altogether omitted in the less perfect example of wood engraving. To put the matter shortly, the second-rate wood engraver uses an outline as an index or pointer to his subject, and he often contents himself with this index or pointer alone, making no effort whatever to represent the true shades of the subject; and the public often prefer this index to the representation of the actual object, because it is easier to follow and to understand. Hence one of the main reasons why a typographic block made from an ordinary negative does not give satisfaction to those who have become accustomed to the mode of treatment adopted by wood engravers. In the photographic block there is no artificial outline, but only the shading. In addition to this, when any part of a figure has the same tone value as an adjacent part of the background, the photographic block makes no distinction between them—they merge into one another; while, in such a case, the wood engraver can make a distinction between the two parts, by making the shading lines incline in a different direction. The effect of photography in bringing about a more perfect system of wood engraving is to be observed in studying the wonderful specimens issued with the Transatlantic monthlies, *Harper* and *Scribner*. Here we often find the artificial outline or index lines either reduced to a minimum or altogether absent, and a fine shading introduced which, when viewed from a little distance, almost strikes the eye like the gradated tints of a photograph. Side by side with the wood-engravings in *Harper*, one often sees photo-typic blocks made by the method of Ives; and in noting the great similarity of the effect to the eye, one hardly knows whether to congratulate the phototypist for his near approach to the most perfect examples of wood engraving, or to give praise to the wood engraver for his skill in so closely realising the gradated lights and shades of the photograph.

In making a type block from a photograph, the first step is to translate the evenly gradated tints of the latter into a line system, or a stipple of corresponding intensities. When a photograph is transferred to a wood block, this is done by the personal skill of the individual who engraves the block; but this is by no means to be regarded as photo-engraving proper, so my remarks will be confined to processes in which the translation is effected automatically.

There are many methods of so translating the tints into points, lines, or dots, that even to mention all would be impracticable. In now talking to you, there is no alternative but for me to assume considerable knowledge of the subject on your part, this course of lectures being of the nature of a supplement or appendix to my previous course.

In my last lectures the method of Asser was illustrated, a photo-lithographic transfer being made on a sheet of starched or pasted paper, made sensitive by means of potassium bichromate; and by putting down such a transfer on zinc, and etching into relief, excellent results may be obtained. It may also be mentioned that, as long ago as 1866, Messrs. E. and J. Bullock, of Leamington, obtained a patent for a mode of photo-lithography in half tone, and a print issued during the year in question with the *Photographic News*, shows that their work was equal to anything that has been done since. The print is before you, and you can judge for yourselves. Why, then, you may ask, did not the process become a great thing commercially, and make its mark? The answer is simply this—the invention came before its time, neither good litho-machining nor zinc-etching being practised at the time. The expired patent of Bullock Brothers, No. 2,954, 1866, will be read with interest, and its value is well illustrated by the fact that the essential points of it have been claimed by very many subsequent patentees. Bullock claims the production of reticulated transparencies, by copying a negative over which a grained surface is laid; this transparency affords the means of making a grained negative; but the method by which their best work was made is a second process included in the same patent. Ordinary or photographic

paper is coated with a glutinous substance, and printed with a reticulated pattern. Let me now quote from the specification :—"In this case the specks of ink themselves form a medium, and by their aid excessive contrasts are avoided, and half-tones secured. Such picture, when so obtained, is passed to a lithographic stone or zinc plate, and a printed proof produced therefrom ; by the aid of chromo-lithography, coloured proofs may be produced." The coating of the paper with a glutinous substance may "be conducted in connection with bichromate of potash or bichromate of ammonia." The said transfer paper may be used, "whether the impression be a lithograph, a zincograph, an impression from an electrotype, or from an engraved or etched plate."

Mr. Dallas' work you have seen before, and there are some specimens before you. He tells me that he supplied tint blocks for journalistic work (*The Garden*) as long ago as 1872.

By transferring a coarsely grained collotype to stone or zinc, a very good grain image is obtained, and the coarse reticulation of the gelatine is very much facilitated by adding chloride of calcium to the sensitive mixture. The following answers very well :—

Gelatine	6 parts.
Water	60 ,,
Bichromate of ammonia	1 ,,
Chloride of calcium	2 ,,

Printing surfaces thus obtained, whether lithographic or typographic, resemble those of Pretsch or of Dallas on the one hand, and those of Sprague on the other hand.

In speaking of the work done by Messrs. Sprague and Co., in which the gradations of the original photograph are translated into a vermicular grain, suited for printing by means of the litho-machine, one must fully recognise the fact that this firm was the first to put photo-mechanical printing from the ordinary gradated negative on a large commercial basis in this country ; while the great extent and variety of work executed by them during the last two years, abundantly proves that there is a large and rapidly extending field for work of this kind. Before you are numerous examples of their work, and in the extensive commercial application of this method, we have a very decided advance since the date of my previous lectures.

In order to obtain a transparency in which the tints are translated into points, lines, or dots, Algeyer and Bolhoevener have recently suggested a method in which a collotype plate is exposed under a negative ; and after this plate has been soaked and inked up in the usual way, the fatty image is reinforced by dusting with an opaque powder. This method is of course dependent on the reticulation of the gelatine for the production of a grain. From such a transparency a negative may be made by contact printing, and from this a photo-litho transfer by any one of the well-known methods.

Meisenbach, of Munich, has recently obtained a patent, in which he claims some details as to well-known methods of breaking up the grain of a photograph by means of a network, and he more especially claims the shifting of the network during the time of exposure. As regards this point, something similar was described by Bertschold in the volume of the *Photographic News* for 1859. Notwithstanding the fact that one cannot find any very striking features in the patent of Mr. Meisenbach, this gentleman has produced some typographic blocks of surprising excellence, examples of which are now before you.

Having now touched on a few stray points, we come to an important feature in connection with the subject, that is to say, the direct translation, by mechanical means, of the gradations of depth existing in the Woodbury relief into corresponding shades of stipple or granulation ; but before entering into these, let me call your attention to a method of granulating the relief itself, which Mr. Woodbury has made the basis of a method by which excellent printing blocks have been made.

Mr. Woodbury exposes his ordinary relief tissue under a transparency with a piece of network interposed, the effect of this being to produce a decided grain all over the high portions of the resulting relief, and no grain over the deep parts, intermediate portions being grained to an intermediate extent. A reverse cast from the grained relief thus obtained is the printing block. This mode of procedure is subject to one disadvantage in actual practice, as the various printing parts of the resulting block do not lie accurately on one plane, as is the case with a block made by etching a plate of zinc into relief. Mr. Woodbury, however, informs me that he has recently overcome this objection, by a modification of the process in which a transfer is obtained directly from the relief. The specimen before you will show

what good work this method is capable of yielding.*

Mr. Fred. E. Ives, of Philadelphia, published, in 1878, a method of translating the smooth photo-relief into stipple, and this method may be regarded as a new departure. According to the method of Ives, as described by him in 1878,† and patented in the United States, the essential features of his method consist in inking the Woodbury relief, and pressing against paper which has been grained or embossed, somewhat after the fashion of bookbinders' cloth. Under these circumstances the projections on the paper become completely crushed down by the inked relief where the gelatine is thickest, and a solid black results, while the more shallow parts of the relief only tip the projection on the paper with ink. Intermediate thicknesses of relief produced a medium effect. You will now please note the effect of pressing this sheet of grained paper against the inked Woodbury relief, a picture in black and white resulting, the shades of the original being represented by the varying extent of the closely packed dots which constitute the picture. The translation into stipple thus obtained may be used as a transfer for putting down on stone or zinc, but if preferred, it may be re-photographed. Ives also made printing blocks by casting from the grained surface which had been compressed by the gelatine relief, although these were not found to be quite equal in quality with those obtained by the first mentioned method. A subsequent modification of Mr. Ives's method gives results much more easily and economically, as he has succeeded in substituting a "swelled gelatine" relief for the more expensively produced Woodbury relief. In a letter to me, Mr. Ives says:—"The relief which I now employ is a plaster cast from swelled gelatine, which is secured so easily that an apprentice seventeen years of age makes them acceptably for Crosscup and West. On the relief the lines and stipple are impressed by means of a printing film of elastic V-shaped stippled lines, in a manner which gives the operator considerable control of the effect. The line and stipple picture on the plaster relief is then stripped off for lithographic transfer or etching, by a method so simple and perfect that it astonishes all who see it done. Formerly, I had to reproduce the impression by photography in the camera, and by this operation could not avoid losing much or the delicacy of the original, which is wonderfully delicate, sharp, and clear in line. I have to secure ruled plates for moulding closer lined printing films before I can apply the transfer method of reproduction for fine work; so it may be months before I shall show you what fine results I can secure in this way."

The broad principle of the Ives method, which consists in pressure of the relief against a grained or stippled surface, has been the subject of several subsequent patents and inventions. We find that, in 1879, Petit, of Paris, took out an English patent for a method nearly identical with that of Ives, and soon

* The following quotation from Woodbury's specification of 1873 will serve to fully elucidate the nature of the process referred to:—"I prepare sheets of bichromatized gelatine such as is used in the process called 'Woodburytype,' and expose these under a photographic positive to the action of light, but interposing between the positive and the gelatine film a transparency on collodion or mica, of what is known as mosquito netting, Brussels net, tulle, and so forth, which has the effect of breaking up the resulting relief into a multitude of fine square hexagonal lines; or for some subjects I interpose a transparency on mica or collodion of any design of a similar nature that will have the same effect, such as an impression from a grained stone, or the same from a number of fine ruled lines. The sheet of gelatine, when washed, will give a relief having the positive photograph represented by a number of lines, instead of the simple half-tone it originally possessed; I then take an impression from this by means of hydraulic or other pressure in any soft metal, and use the block so obtained for printing at a type press where only a few copies are wanted; but where large numbers are required, I electrotype the same in the ordinary way. I prefer to use diffused daylight or sunshine through ground glass or tissue paper to produce the relief, as in that case the light in the parts that represent the white creeps round the lines, thus partially obliterating them in that part, and leaving them strongest only in the parts printing dark. I sometimes adopt another method. I take a negative of the network by transmitted light, and copy this together with the negative to be reproduced, thus producing a positive with the lines already thereon, from which I proceed to make a relief and blocks, as stated."

† The following reprint of Ives' original declaration will be of interest:—Ithaca, N. Y., Aug. 12, 1878. I, the undersigned, have, to-day, invented a method of obtaining relief plates for the typographic printing press, from ordinary photographic negatives, which may be described as follows:—1st. From an ordinary photographic negative, a relief in gelatine, similar to that used in the Woodburytype process, but perhaps in lower relief, is obtained. 2nd. This relief is carefully and uniformly inked with fine printers' ink, and pressed between two flat surfaces (or between rollers), against paper or other material, upon which is stamped, or otherwise produced, a fine grain, or other suitable surface. The inked relief being highest in the black parts, presses down the grain of the paper on the corresponding parts, and the removal of the ink by the paper from those parts of the relief produces a black impression, while upon those parts where the relief of the gelatine is lower, the grained surface is pressed less, and the ink taken up in spots, the size of which depends upon the grain of the paper and the amount of pressure, and producing an effect similar to that of crayon sketches made upon such a surface. 3rd. Relief plates may be made from this impression, either by the usual photo-typographic processes, or, perhaps, by obtaining a cast or electrotype of the impressed surface of the paper or other material used to receive the impression from the gelatine relief.—Fred. E. Ives.

after another patent by Dredge followed; this latter, however, indicating novel methods of working. A process of quite a similar character is the "Crayontype" of Ad. T. Eggis, which was published in the *Photographic News* a short time ago. Mr. Eggis, instead of inking the relief, takes an inked film, such as manifold copying paper, and lays this on the relief. The grained paper is now placed over and pressure is applied. If the grained paper sold for producing crayon effects in lithography is used, very excellent transfers are obtained. Mr. Barker will illustrate the process to you.*

Other modes of effecting the translation of the relief by pressure on grained surfaces have been patented by Mr. Żuccato, and some of these will be demonstrated to you by Mr. Barker.

The first method consists in first planing a piece of type metal or similar surface in a series of ridges, or a series of pyramids, as the case may be. The plate is then inked, and instead of pressing the relief directly on the inked plate, a piece of very thin paper is interposed; the relief crushes down the pyramids in proportion to its depth. The pyramid of type metal is spread out, and forms a sharply cut outline on the paper, and in this way a transfer is obtained which has a remarkable clearness of outline, almost like the cleanest cuts of the graver.

It will illustrate the matter better if, instead of inking the plate first, the relief is pressed directly against it, and you will then be able to see the flattening of the lines or pyramids.

Two other modes of working have also been patented by Mr. Zuccato. In one he interposes between the relief and a sheet of transfer paper a piece of gauze, or a piece of silk which has been inked with transfer ink. Of course what then takes place is similar to what happens in the case of the plate; the threads of the gauze get crushed out to a greater or less extent, and form lines of greater or less width, but this method in which the gauze is crushed down is not nearly so perfect as the method with the plate of type metal.

A third mode of working, which Mr. Zuccato also claims in one of his specifications, is the pressing of the relief upon a lithographic or zincographic surface on which an ink stipple has been impressed. The stipple gets crushed out more or less, according to the extent of the pressure; this of course depends on the thickness of the relief.

Messrs. Brown, Barnes, and Bell, of Liverpool, have recently made some excellent blocks, and, judging from the appearance of the prints, they appear to me to be likely to have been produced by some method more or less resembling the Ives' process; still I have no knowledge on this point. These gentlemen have made certain patent claims, but as various methods are referred to, one cannot judge from the specifications as to what process is actually employed.

Before you go, perhaps you will look at some reproductions of phototype blocks, which Mr. P. Barry has made by casting in brass. The details are wonderfully preserved, but it does not appear to me that this process of reproduction is likely to supersede electrotyping.

* Mr. Eggis, writing in the *Photographic News*, thus describes the method:—"This process gives results good enough to have allowed the taking of a patent, but I find it preferable to describe it for the public benefit. I call it crayontype, for the images it produces are much like those obtained by the artist with a lead pencil (crayon in French). This is how I proceed. I procure or produce, to begin with, a gelatine positive on best plate glass (*glacé*) obtained by the known ways, in relief. The highest point, when dry, should not have more than one millimetre. The other necessary implements are—1st, grained (or lined) paper, of same kind as is used by the artists for their drawings destined to be etched; 2nd, a few sheets of blue or black transferring paper (*papier à calquer*, thin paper coated with a greasy substance and coloured); 3rd, a small press. Having these at hand, I take the gelatine positive, lay it on the stone or metal table of the press; on the relievo I place a sheet of transferring paper, the prepared face turned upwards. On this I lay the stippled or grained autographic paper, face downwards, touching the greased sheet. Over all this I place a fine polished steel sheet, well planed. I put the whole under the press, and slowly pull down the lever in such a manner as to give a smooth and graduated impression. Afterwards separating the whole, I find on the grained paper a good and often a perfect stippled reproduction of the gelatine relief. This reproduction being formed by a greasy substance, I am able to transfer it at once directly on stone, for lithographic purposes, or on metal, to be etched in the usual manner. The production of such an image will be easily understood; it is much the same as the direct drawing with a pencil on the paper. Instead of the artist pressing more or less his graphite on the paper, the gelatine relief (which corresponds more or less to the lights or shadows of the photo) presses more or less on the paper, and gives the true gradation of the original. The work of the hand is mechanically imitated very closely indeed. The crayontypes present a different grain, which may be chosen according to the work to be done. It is at least more artistic than the usual regular stippling."

LECTURE III.—DELIVERED FEBRUARY 11TH, 1884.

INTAGLIO PLATES. COLLOTYPES. PHOTO-MECHANICAL METHODS, AS APPLIED TO THE DECORATION OF POTTERY. MISCELLANEOUS PROCESSES.

Perhaps the most perfect mode of printing is from an incised or "cavity" plate, as by this method the most minute markings can be reproduced with a degree of perfection which is not attainable either in the case of lithography or typography; but what is, perhaps, of more importance, is the circumstance that by adjusting the depth of the cavities to the requirements of the subject, not only can the engraver of the plate determine which portions of the print shall be covered with ink, but he can also determine how much ink shall be devoted to each part of the subject. To put the case in another way, not only can the engraver plot out his subject in black and white, but, within certain limits, he can determine how black the lines shall be.

Intaglio plates made by the aid of photography have been produced in great perfection by several methods, but up to the present time there has not been a very large market for them; partly, perhaps, from the considerable expense attending the work of printing from them. Intaglio plates are, even in the present day, generally printed from by hand; and this notwithstanding the fact that very excellent machines have been constructed for the purpose of plate printing.

One may generally put it that any transfer method for the production of a lithographic or typographic surface may also be applied to the production of intaglio plates, it being merely necessary to make a transfer in which the whites and blacks are reversed, to put this down upon a copper or steel plate, and to etch away the uncovered parts by suitable means.

It will be thus seen that, by the Ives method and its modifications, intaglio plates may readily be made; but there is but little inducement to do so, as such plates will not give much better impressions than the typographic or lithographic surfaces produced by similar methods, so that the great expense of printing from the intaglio plate steps in as a determining circumstance. There is, however, an exception in the case of printing surfaces to be used for pottery decoration. For this purpose intaglio plates are generally used, the method of printing being so rough and simple that the impressions cost about the same as prints from a type block. Hence it happens that intaglio plates made by means of photography have a special value to the potter. On the bed of this little press is a Woodbury relief made from a positive, that is to say, just such a relief as is used for the stannotype method, those parts of the relief corresponding to the whites of the original being high, and those parts of the reliefs corresponding to the darks of the original being low. Mr. Barker has uniformly inked it by means of an ordinary printer's roller, and let me now take an impression from the inked relief on a sheet of paper which has been grained in relief by means of pressure against a ruled plate. You see that a negative transfer in stipple is thus obtained, and when this is transferred to a copper plate, it serves as a resist to the etching fluid, a solution of perchloride of iron in water being one of the best mordants.

An extremely simple and expeditious method of engraving line subjects upon copper plates is the bichromated albumen process, practised with much success by Gobert and others. A plate is covered with a film of bichromated albumen, and exposed under a transparency, until the whole of the ground—that is the part not covered by the lines of the transparency—is rendered insoluble. The plate is next washed with cold water, so as to remove the albumen from the lines, after which the etching is effected by an alcoholic solution of ferric chloride.

The following details will be sufficient to enable the method to be carried into practice. One hundred cubic centimetres of albumen are mixed with a solution of two and a half grammes of bichromate of ammonia in fifty cubic centimetres of water, and after having been well beaten, the mixture is filtered. A carefully cleaned plate of copper is now coated with the mixture, and after the excess has been well drained off, the plate is dried at a very gentle heat, it being retained in a horizontal position

meanwhile. The exposure required is by no means a long one, half a minute in moderate sunshine being sufficient in ordinary cases; but this must, of course, be learned by experience. Instead of developing (washing away the unaltered albumen) in plain water, it is better to use a weak solution of aniline red or magenta dye, as under these circumstances the ground becomes tinted, and the progress of the development can be watched. When the plate has been dried, nothing now remains but to varnish the back and edges with an ordinary black varnish, such as the so-called Brunswick black, and to etch. The etching bath is made by dissolving one part of per-chloride of iron in five of alcohol, and ten minutes is generally a sufficient time for etching to the required depth.

On the table are some early specimens illustrating the photo-engraving method of Mr. Woodbury—now so successfully carried into practice by Messrs. Goupil and Co., of Paris. A gritty powder—crushed glass answers well—is incorporated with the gelatine used for making the Woodbury relief, and a leaden reverse being taken by pressure from the rough relief, the leaden reverse is reproduced by a twofold electrotyping. This reproduction of the leaden reverse is the printing plate.

The method which Major de La Nöe calls typogravure is in reality an intaglio process, but the printing is conducted as in the case of ordinary zincography. The details are as follows:—A prepared zinc plate is coated with a film of sensitive bitumen by well known means, and exposure is made under a transparency or a tracing, so that when development is carried on with turpentine or benzole in the usual way, the lines alone are bare. The plate is now etched with dilute nitric-acid (1 and 40) until a depth of about a 250th of an-inch is reached, after which the plate is dried and once more coated with bitumen. The ground is now polished off with a stick of charcoal, leaving the bitumen in the lines; after which the plate is gummed and printed from by the usual zincographic method. This process is admirable for map work, although it is obviously inapplicable for the reproduction of subjects with widely extended blacks; and it has the advantage that the lines show no tendency to spread.

Before going any further, you may with advantage look back at some of the older examples of photo-engraving in half tone. Here are some specimens done by Talbot's etching process, over 25 years ago, and they are admirable; while yonder is an example done by Mr. Dallas, in 1864, and issued with the *Photographic News* of that year. These examples of work done by Pretsch about 20 years ago are quite sufficient to prove that good work is not altogether a thing of to-day. Among the newer methods, that of Klic deserves special mention; and this specimen, which was issued with the "Year Book of Photography for 1882," will serve to show you how perfectly this method can render the lighter or more delicate shades of a photograph. Messrs. Annan Brothers, of Glasgow, are working the process commercially in this country, and they have turned out some admirable plates. Klic has not published his method, but it is said to be an etching process, and the following details are given in a recent number of the *Photographic News*:—

"The process itself was a secret at first, but we are informed that the principle of working is as follows:—A copper plate is dusted with powdered asphalt, and the plate is heated, so that the asphalt becomes nearly melted. A negative carbon print is now transferred on to the copper plate, and the plate, now covered with the negative in carbon, is etched, at first by a strong solution of per-chloride of iron, which penetrates only the thinnest parts of the picture; then by a weaker solution of the same salt, the solution etching through the thicker parts. By employing more and more diluted solutions, it is possible to etch through thicker and thicker layers of gelatine, so that only the high-lights remain unetched."

On the table are some exquisitely fine plates made by Messrs. A. and W. Dawson, the managers of the Typographic Etching Company, these being reproductions of subjects after nature, and of difficult drawings in wash.

Major Waterhouse has been remarkably successful, during the past few years, in making intaglio plates, and he has published the details of his method. The process is a modification of one introduced some time previously by Geymet, and it is based on the mechanical reticulation or breaking up of the Woodbury relief.

A Woodbury relief is developed upon a plate of silvered copper (but the relief need not be nearly so high as that required for the Woodbury process; in fact, an ordinary carbon print will answer), and when the relief is taken out of the developing water, it is dipped into a solution of potassium bichromate, drained and dusted over with fine sand; this sand having been previously waxed by being heated in an

iron pot, and stirred up with a small proportion of wax. The layer of waxed sand is allowed to remain on the film until it is quite dry, when it is brushed off, leaving the gelatine granulated or pitted all over; the pits being deepest in the thick parts. The plate is now blackleaded, and a cast is made in the electrotype bath; this cast being the printing plate.

The specimens on the table will show you what excellent work can be done with this method, and you must remember that Major Waterhouse has not only published full working details,* but he has demonstrated the process before several gentlemen interested in the matter; moreover, he has not patented the method.

Before you are some fine examples of the application of photo-engraving to pottery decoration, by Mr. F. S. Emery, of Burslem—and one photographic method which this gentleman adopts for the reproduction of pottery designs is of special interest. He coats a plate with sensitive bitumen, puts down upon this surface a transfer from the plate to be reproduced, and exposes to light until the ground is insoluble. Development is now effected with the usual solvents—say, a mixture of turpentine and benzole; only those parts of the ground which were protected by the transfer dissolving. The etching is affected by perchloride of iron.

As regards collotype printing, the progress to be reported is principally as regards extension of work and some minor details; while as far as this country is concerned, the Autotype Company practically hold the thing in their own hands. Excellent as the specimens of foreign work may be which are placed before you to-night, you will find nothing better than the specimens shown by the Autotype Company. In Germany, the steam press is largely applied to the rapid production of collotypes, and before you are drawings of the machine collotype press constructed by Messrs. Schmiers, Werner, and Stein; the most striking feature being the large number of rollers, used in order to ensure equal inking and damping. The transfer of collotypes to porcelain has been practised to a small extent, vitrifiable colours being dusted on afterwards, but the results obtained have not been very satisfactory.

Collotyping in colours from several plates has been introduced to compete with chromolithography for fine work, but the only examples exhibited in this country are, I believe, some shown by Mr. Meyerstein, and a selection of which is now before you.

Before you go, do not fail to look at some intaglio plates intended for the decoration of porcelain as made by Mr. Dallas, and you will also find some prints from them. Mr. Dallas does not tell us how he makes them.

As you may well suppose, the things omitted from this short course of lectures are more numerous than the things discussed; far more progress having been made than can be described in three hours.

You will, before you go, allow me to express the obligation we are all under to Mr. G. E. Barker, who has so ably assisted me in showing you what you have seen.

Photographic News, p. 1880, p. 568.

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